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Unearthing the Truth about (Dirt) Soil


UNEARTHING
THE TRUTH
ABOUT
DIRT
SOIL
BY KRIS
GALLAGHER

The ground under your feet. As clear as mud. Down to earth. Dirt cheap. Feet of clay. The English language is peppered with references to what we stand on, yet most people know very little about it.

First, it's called *soil*, not dirt, says Jim Montgomery, associate professor of environmental science and studies in the College of Science and Health (CSH). *Dirt* implies a mess we need to clean up. *Soil* is the composite that nurtures every growing thing on land. It also affects human health and well-being in many ways.

SOIL IS POWERFUL

"Soils do a lot of very important things for us," says **Karis McFarlane (CSH '01)**, an earth scientist at Lawrence Livermore National Laboratory, about 35 miles southeast of Oakland, Calif. At the top of the list? Most of the food we eat originates in soil.

Soil serves as a sponge, absorbing rain and thereby decreasing erosion and flooding. Then, it filters contaminants out of that water and captures—or "fixes"—nutrients such as nitrogen and phosphorus so that plants can use them. "That's important, because if we get too much nitrogen or phosphorus running off into our streams, lakes and rivers, we can have algae blooms and other damaging outcomes," says McFarlane.

McFarlane studies how carbon and other elements are stored and cycle between the upper and lower layers of different soils. "Carbon is the currency of energy throughout the ecosystem," she says. "Plants fix the carbon that they get from the atmosphere and turn it into sugar, and that feeds everything else. Carbon powers the whole ecosystem."

Soil types with large particles, such as sand, capture less carbon than soils with small particles, such as clay. "The smaller the particle size, the higher the surface area, so more carbon and nutrients can stick to it," says McFarlane. That's why water drains quickly from sand and few plants grow in it. Conversely, plants love small-particle, loamy soil, which stores about three times as much carbon as does the atmosphere. Soils such as peat bogs and permafrost store even more.

That makes soil a major player in climate change.

Jim Montgomery playfully blows on the barrel of a portable X-ray fluorescence detector after scanning about 30 neighborhood soil samples for lead.

"LEAD IS LIKE THE CABOOSE OF A TRAIN; IT HITCHES A RIDE ON SOIL PARTICLES."

Jim Montgomery, associate professor, environmental science and studies

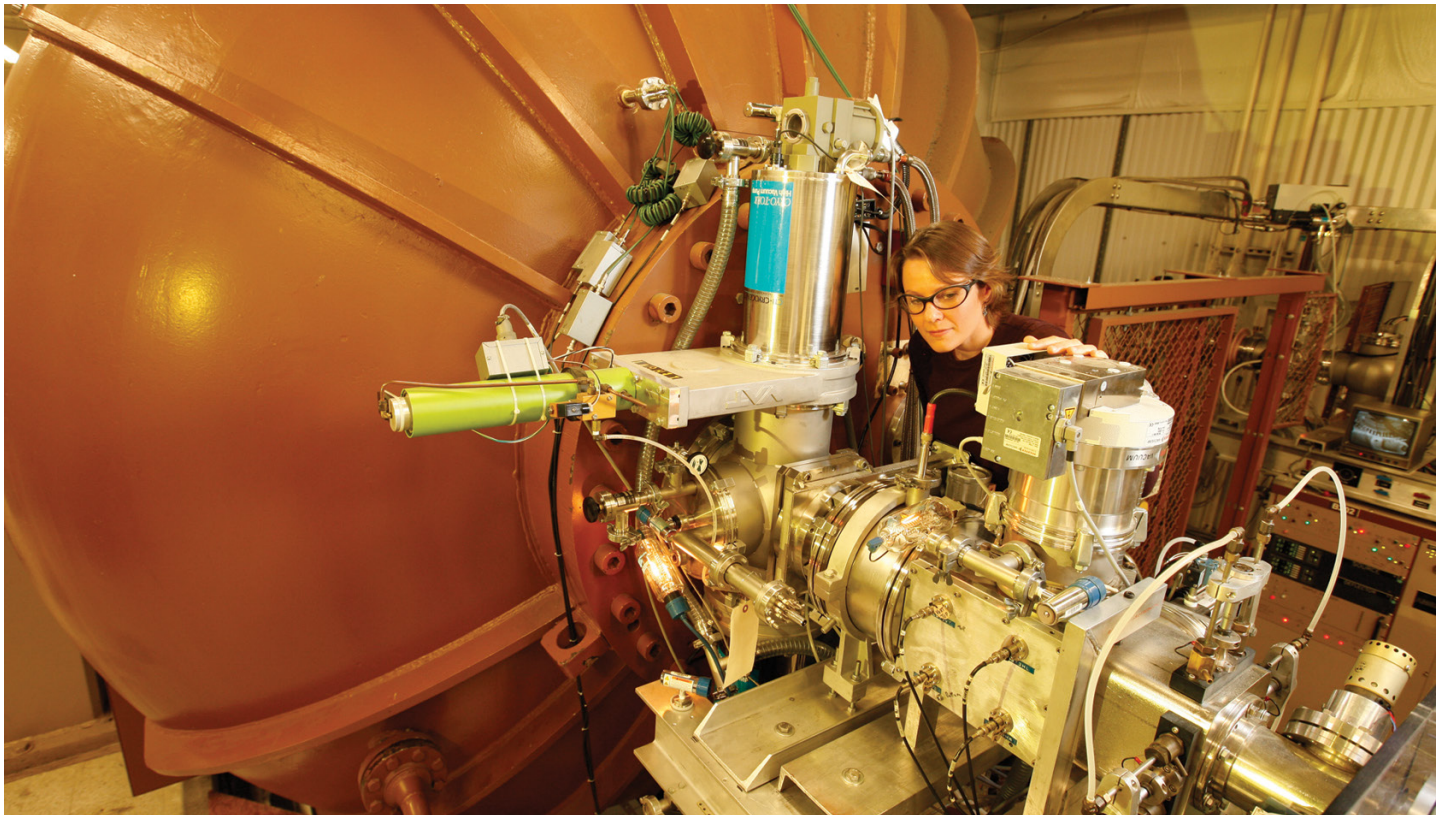

Photo by Lawrence Livermore National Library

Earth scientist **Karis McFarlane (CSH '01)** uses an accelerator mass spectrometer to measure radiocarbon in soil, water and air samples, enabling her to track carbon-related climate change.

McFarlane explains that as greenhouse gases increase, the planet gets warmer, which lengthens the growing season. The long season enables more carbon to be fixed in the soil, which offsets some of the greenhouse gases in the atmosphere.

However, higher temperatures also release carbon that has been trapped in cold or wet soils such as permafrost or peatlands. "The carbon that's been sitting in that soil for thousands of years can be released back into the atmosphere, furthering the increase in greenhouse gases and making climate change worse," she says.

Through sustainable management, "we can make choices that impact these positive or negative feedback cycles between the soil and the atmosphere, including protecting vulnerable places like peatlands or choosing forest and agricultural management practices that protect soil resources," McFarlane says. "As somebody who chose to go to DePaul, doing things that are relevant to society feels really good to me."

DIGGING INTO URBAN SOIL

Unlike the wilderness soils that McFarlane studies, urban soil is a hodgepodge of materials, says Montgomery. It includes native topsoil, additional soil that has been churned up or brought in during construction, and anthropogenic artifacts: human-created materials ranging from old bricks to ice cream sticks.

The past economic use of an area largely determines what is in the soil, he says. The chemicals found in the soil of industrial cities such as Chicago and Detroit differ significantly from the soil contents in cities low in industrial development, as well as suburban subdivisions built on former farmland. Lead is common in areas with houses built before lead-based paint was taken off the market in 1978.

Montgomery began investigating Chicago soil about six years ago after a student suggested a class project evaluating land near the Lincoln Park Campus. After sampling 30 sites, the students found high lead content near North Avenue and the Chicago River, a former industrial area.

"That got me thinking about how do I continue this project in a way that integrates DePaul's mission?" Montgomery recalls. He's troubled about childhood exposure to lead, which can cause permanent neurological damage.

Photo by DePaul University/Jeff Carrion

Julia Lippert saw the need to educate Chicago residents about the level of lead in their soil.

Photo by Tom Evans

By analyzing soil and water samples from low-income neighborhoods, DePaul faculty and students allay fears and empower residents to minimize actual risks.

Low-income communities often are situated on former industrial sites, yet their residents are least able to afford expensive soil analysis. "I decided I would offer free soil testing to whoever wants it and help educate them about what to do about the results."

Via flyers and word of mouth, Montgomery began recruiting homeowners and renters to provide soil samples. Student lab employees analyzed some of the samples, while others were evaluated by students in Montgomery's environmental soil science course. Students in that course created the report template and present the results to the homeowner or renter.

If he can get the funding, Montgomery plans to evaluate soil from all 77 Chicago neighborhoods, as well as expand into the suburbs. More importantly, he wants to teach people how to work with the soil they have. "My mission is not to incite panic, because I don't think there is anything to be panicked about, but to empower people by educating them about what's in their soil," he says.

With the aid of a grant from the Vincentian Endowment Fund, Montgomery partnered with Julia Lippert, a clinical assistant professor for the Master of Public Health program in the College of Liberal Arts and Social Sciences, to begin educating residents in underserved communities about how they can protect their families. Last year, they piloted a soil and water health fair in Chicago's Austin neighborhood, which has an industrial legacy.

Teens from a neighborhood organization, BUILD Chicago, recruited residents to attend the fair and bring soil and water samples from their homes for analysis. Students from DePaul's Master of Public Health, environmental science and environmental studies programs analyzed the samples and explained test results.

"For most of the people, water wasn't an issue. But, among the soil samples, about 40 percent had elevated levels that we wanted to control," Lippert says. Students taught community members about free or inexpensive methods to lessen exposure to lead and other chemicals (see page 12, "Easy Ways to Prevent Contamination"). The event was so successful that it is being expanded to six additional locations in 2018, underwritten by DePaul's academic initiatives fund.

Photo by Tom Evans

Kelly Tzoumis, professor of public policy studies, is partnering with a colleague in Turin, Italy, on a study about how formerly industrial cities reclaim riverbanks along still-polluted rivers.

"WE LET BROWNFIELDS SIT FOR YEARS, DECADES, AND THEY MAY NOT EVEN BE CONTAMINATED."

Kelly Tzoumis, professor of public policy studies

THE PRICE OF IGNORANCE

Some project participants are eager to know if there is lead in their soil, but others ask not to be told. Although Illinois law does not require property owners to remediate lead or other contaminants, if they are aware of contamination, they must disclose this fact to prospective buyers. Thus, owners run the risk that buyers may demand a reduced price or simply walk away from the deal.

Kelly Tzoumis, professor of public policy studies in the College of Liberal Arts and Social Sciences, says there are other problems that stem from contaminated property. Tzoumis studies policy related to "brownfields," land that is abandoned because of perceived or actual contamination. Rather than take a risk on a parcel of urban property, developers and the banks that fund them prefer to build on former agricultural land, contributing to urban sprawl, long commutes and the loss of farmland.

"It costs so much money to invest in an environmental assessment and to dig around [at urban locations] that it's

EASY WAYS TO PREVENT CONTAMINATION

Think you might have lead or other chemicals in your soil? Formal remediation can be expensive, but there are a number of inexpensive tactics for protecting your family.

- **Take your shoes off.** By leaving shoes by the door, you don't track dust or soil throughout your home.
- **Wipe those paws.** Keep a towel by the door to wipe pets' feet. This prevents them from tracking potentially contaminated soil into your home as well as ingesting it by cleaning themselves.
- **Keep the dust down.** Lead is often inhaled via dust particles. Dust and damp-mop regularly.
- **Wash hands.** It's especially important for anyone who's been digging in the dirt.
- **Wash toys regularly.** Young children and pets put toys in their mouths.
- **Wash vegetables.** Be sure to wash vegetables, especially the ones that grow underground, very well before eating. You can make your own vegetable wash by adding vinegar to cold water.
- **Cover your nose and mouth.** Prevent dust inhalation by wearing a bandana or face mask if you are gardening or digging in the soil.
- **Put it under the bed.** Create a raised bed for gardening using potting soil or compost. Make a raised sandbox for children using clean sand from a store.
- **Bury it.** Cover high-traffic areas with potting soil or compost. You can make your own fresh dirt by composting leaves, branches and vegetable scraps.

Photo by DePaul University/Jeff Carrion

Chicago Public Schools students inspect vegetables in the DePaul Urban Garden.

just easier for developers to go out to these areas where there is no environmental risk," Tzoumis says. Yet brownfield redevelopment can pay off handsomely. Tzoumis points to Block 37, now a thriving retail complex in Chicago's Loop; Navy Pier, a booming entertainment destination; and her personal favorite, Millennium Park.

"As a child, I remember watching the freight trains there. That was a very ugly part of the city," Tzoumis says. Now the park is "a vibrant outdoor recreational area" that features a concert hall, ice rink, climbing wall, native-plant beds and the popular attraction "Cloud Gate," a.k.a. "The Bean."

A FOOD DESERT OASIS

According to the National Gardening Association, more than a third of all households in America grow food at home or in a community garden, up more than 17 percent since 2008, and community gardening has increased 200 percent. As long as people take measures to protect themselves from contaminated soil, the rising popularity of community gardens is a good trend, says Lippert.

"A lot of issues in Chicago stem from lack of access … to healthy food," she says. "Community garden programs educate people about nutrition and the importance of good food as well as provide access to fruits and vegetables."

Implementing school garden programs, especially at Chicago Public Schools, is the mission of the nonprofit Gardeneers. "School administrators have told us that the garden at their school is the only fresh, local vegetable option available to them," says **Rosa Fitz (CSH '16)**, a development associate and former educator for Gardeneers.

Gardeneers staff members partner with teachers to introduce students to a variety of vegetables, many of which they may never have seen. Students help decide what will be planted and take home recipes along with the fresh produce. "Students go from not

Photo by Tom Evans

"Our school gardens provide one little piece of this larger puzzle" of providing fresh food in underserved communities, says **Rosa Fitz (CSH '16)** of Gardeneers, which creates raised-bed gardens at Chicago Public Schools.

knowing how a tomato grows to having a favorite type of tomato," she says.

Gardeneers staff work with principals to find a location for the school garden, which may be onsite or on a nearby lot. Parents and community members are recruited to help prepare the ground soil and construct anywhere from a couple to dozens of raised beds that will sit safely on top of it.

"Even after you decide where to put the garden, you can't really grow food in the ground due to high levels of heavy metals and other toxins in the soil, which is a huge issue on the South and West sides of Chicago," Fitz says. So, the construction team first caps the ground with geotextile landscape fabric that prevents contaminants from seeping upward and roots from stretching downward into the contaminated soil. Then, they cover the ground with wood chips to discourage weeds from taking root and help with moisture retention.

Next, workers build simple box-frame beds and fill them with purchased topsoil. Bare areas between the beds are covered with mulch to prevent potentially contaminated soil from blowing into the beds and protect gardeners. Thorough hand- and vegetable-washing are musts.

HOW DOES YOUR GARDEN GROW?

Gardeners in urban areas should follow the example set by the Gardeneers, Lippert says. Lead-based paint that has peeled away from older buildings may have contaminated the ground, so gardens should be placed as far from the buildings as possible and planted in raised beds.

Fitz adds that sunflowers belong in urban gardens because they draw lead out of the soil and into their leaves, stems and flowers. She recommends trimming buds before they bloom to protect insects and birds, and disposing of the entire plants in the landfill at the end of the season. In six to 10 years, sunflowers will remove most of the contaminants.

"We want to be there as a resource for the community to educate people about what's in their environment, to alleviate some of the fears and to teach them what they can control," Lippert says.

Do you want to learn what's in your soil? To request a free soil analysis from DePaul's Department of Environmental Science and Studies, go to ***depaulmagazine.com***.